ABSTRACT

In the last 10-15 years there has been a significant effort toward development of new, more efficient and faster materials for detection of ionizing radiation. A growing demand for better scintillator crystals for detection of 511 keV gamma particles has been due mostly to recent advances in modern imaging systems employing positron emitting radionuclides for medical diagnostics in neurology, oncology and cardiology. While older imaging systems were almost exclusively based on BGO and NaI:Tl crystals the new systems, e.g. ECAT Accel, developed by Siemens/CTI, are based on recently discovered and developed LSO (Lu2SiO5:Ce, Ce-activated lutetium oxyorthosilicate) crystals. Interestingly, despite very good properties of LSO, there still is a strong drive toward development of new scintillator crystals that would show even better performance and characteristics.

In this presentation we shall review spectroscopic and scintillator characterization of new complex oxide crystals, namely LSO, LYSO, YAG, LuAP (LuAlO3, lutetium aluminate perovskite) and LuYAP activated with Ce and Pr. The LSO crystals have been grown by CTI Inc, LYSO, LuAP and LuYAP crystals have been grown by Photonic Materials Ltd, while YAG and LuAP crystals have been grown by ITME (Warsaw). All these crystals have been characterized at IF UMK (Torun). We will review and compare results of measurements of scintillation light yields, scintillation time profiles, VUV spectroscopy and low temperature thermoluminescence performed on these crystals. We will demonstrate that all the experiments clearly indicate that there is a significant room for improvement of both YAG, LuYAP and LuAP:Ce. While both LSO and LYSO perform very well, we note also that LuYAP:Ce, LuAP:Ce and YAG:Pr offer advantages in systems based on a phoswich design (two different scintillator crystals) and, after a likely improvement of some parameters, they may also present a viable alternative in single crystal machines.